

# Educational Planning and Assessment System (EPAS) College Readiness Standards and *Program of Studies* Standards Alignment

## Introduction

### Test: Mathematics

#### Kentucky's *Program of Studies* (POS) and the College Readiness Standards (CRS)

The *Program of Studies*, Kentucky's mandated curriculum for all Kentucky schools, is a comprehensive document. Therefore, the CRS is embedded within the *Program of Studies*. While there has been an effort to align the standards as closely as possible in this document, readers will see that in some cases, there is not an exact match for the CRS within the POS. In these cases, the Kentucky Department of Education has found that the skill or skills identified within the CRS are often a component of a more complex POS standard and that the POS standard to which we have aligned the CRS may include the expectation that students demonstrate a variety of other, related skills.

In each tested area, educators should note the importance of reading and critical thinking skills necessary for students to perform well on the tests. It also is important to note that, from grade to grade, some standards may be the same or very similar. In these cases, teachers are expected to continually refine instruction so that students use increasingly complex skills to achieve the standards for each consecutive grade level.

#### How to Use the Document

This document is divided into tables with two columns. The left-hand column contains the College Readiness Standards (CRS) and descriptions of the skills and knowledge associated with what students are likely to know and be able to do based on their EXPLORE, PLAN and ACT test scores. The second column contains the mathematics content standards from the *Program of Studies* that most closely match each CRS.

Teachers may use this document to link instruction with assessment. By identifying the connections between the CRS and the POS, educators may better understand how the ACT College Readiness Standards are embedded within Kentucky's curriculum.

#### Example

**CRS Mathematics** GRE (33-36) Solve problems integrating multiple algebraic and/or geometric concepts.

#### **POS Mathematics**

MA-HS-AT-U3 Algebra Thinking

Students will representation mathematical situations and structures for analysis and problem-solving.

The CRS statement is much more general than what the POS standards state. While these two standards do not provide an exact match, the POS standard identified most closely matches the CRS.

### **The Mathematics Test**

The EPAS Mathematics test “requires students to analyze problems in real-world and purely mathematical settings, plan and carry out solutions strategies, and verify the appropriateness of solutions.” Students must demonstrate understanding of mathematical terminology. Students will be required to apply definitions, algorithms, theorems, and properties to solve problems. Students also will be expected to analyze and interpret data.

### **Supplemental Information**

The specifications for the Mathematics test on the EXPLORE, PLAN and ACT are located in the supplemental information section for Mathematics on page 52.

# Mathematics

## POS/CRS Alignment

### Strand 1 – Basic Operations & Applications (BOA)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Perform one-operation computation with whole numbers and decimals	<b>MA-6-NPO-S-NO2</b> Students will add, subtract, multiply, divide and apply order of operations with whole numbers, fractions and decimals to solve real-world problems.
Solve problems in one or two steps using whole numbers	<b>MA-7-AT-S-EI3</b> Students will model and solve real-world problems with one- or two-step equations or inequalities (e.g., $2x+1=9$ , $3x+3<9$ ).
Perform common conversions (e.g., inches to feet or hours to minutes)	<b>MA-4-M-S-SM1</b> Students will convert units (e.g., linear, weight, money, time) within a measurement system (e.g., 2 feet = 24 inches).  <b>MA-5-M-S-SM1</b> Students will relate and convert units (e.g., linear, volume, weight) within a measurement system (e.g., 125 cm = 1m 25 cm).  <b>MA-6-M-S-SM2</b> Students will estimate, compare and convert (meaning to make ballpark comparisons/not memorize conversion factors between U.S. and metric) units of measurement for length, weight/mass and volume/capacity within the U.S. customary system and within the metric system: <ul style="list-style-type: none"> <li>length (e.g., parts of an inch, inches, feet, yards, miles, millimeters, centimeters, meters, kilometers);</li> <li>weight/mass (e.g., pounds, tons, grams, kilograms);</li> <li>volume/capacity (e.g., cups, pints, quarts, gallons, milliliters, liters).</li> </ul>
Score Range 16-19	
Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent	<b>MA-7-NPO-S-NO2</b> Students will extend concepts and application of operations with fractions and decimals to include percents.

\* PLAN and ACT only

† ACT only

Solve some routine two-step arithmetic problems	<b>MA-6-NPO-S-NO2</b> Students will add, subtract, multiply, divide and apply order of operations with whole numbers, fractions and decimals to solve real-world problems.
Score Range 20-23	
Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average	<b>MA-7-NPO-S-RP3</b> Students will develop proportional reasoning and apply to real-world and mathematical problems (e.g., rates, scaling, similarity).
Score Range 24-27	
Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)	<b>MA-8-NPO-S-RP2</b> Students will derive and use formulas for various rates (e.g., distance/time, miles per hour).
Score Range 28-32*	
Solve word problems containing several rates, proportions, or percentages	<b>MA-HS-NPO-S-RP1</b> Students will calculate and apply ratios, proportions, rates and percentages to solve problems.

\* PLAN and ACT only

† ACT only

Score Range 33-36†	
Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)	<b>MA-HS-NPO-S-RP1</b> Students will calculate and apply ratios, proportions, rates and percentages to solve problems.

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# Mathematics

## POS/CRS Alignment

### Strand 2 – Probability, Statistics, & Data Analysis (PSD)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Calculate the average of a list of positive whole numbers	<p><b>MA-6-DAP-S-CD2</b> Students will determine and apply measures of distribution (mean, median, mode, range).</p> <p><b>MA-7-DAP-S-CD2</b> Students will determine, apply and compare measures of mean, median, mode and/or range, as appropriate to the problem situation.</p> <p><b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.</p>
Perform a single computation using information from a table or chart	<p><b>MA-6-DAP-S-DR2</b> Students will collect, organize, construct, analyze and interpret data in a variety of graphical methods, including line plots, line graphs, circle graphs, bar graphs and stem-and-leaf plots.</p>
Score Range 16-19	
Calculate the average of a list of numbers	<p><b>MA-7-DAP-S-CD2</b> Students will determine, apply and compare measures of mean, median, mode and/or range, as appropriate to the problem situation.</p> <p><b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.</p>
Calculate the average, given the number of data values and the sum of the data values	<p><b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.</p>

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Read tables and graphs	<p><b>MA-6-DAP-S-DR2</b> Students will collect, organize, construct, analyze and interpret data in a variety of graphical methods, including line plots, line graphs, circle graphs, bar graphs and stem-and-leaf plots.</p> <p><b>MA-7-DAP-S-DR1</b> Students will collect, organize, construct, analyze and interpret data and data displays in a variety of graphical methods, including circle graphs, multiple line graphs, double bar graphs and double stem-and-leaf plots.</p> <p><b>MA-8-DAP-S-DR1</b> Students will collect, organize, construct, analyze and make inferences from data in a variety of graphical methods (e.g., drawings, tables/charts, pictographs, bar graphs, circle graphs, line plots, Venn diagrams, line graphs, stem-and-leaf plots, scatter plots, histograms, box-and-whiskers plots).</p>
Perform computations on data from tables and graphs	<p><b>MA-6-DAP-S-DR2</b> Students will collect, organize, construct, analyze and interpret data in a variety of graphical methods, including line plots, line graphs, circle graphs, bar graphs and stem-and-leaf plots.</p>
Use the relationship between the probability of an event and the probability of its complement	<p><b>MA-HS-DAP-S-P11</b> Students will determine the probability of an event and the probability of its complement.</p>
Score Range 20-23	
Calculate the missing data value, given the average and all data values but one	<p><b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.</p>
Translate from one representation of data to another (e.g., a bar graph to a circle graph)	<p><b>MA-8-DAP-S-DR4</b> Students will relate different representations of data (e.g., tables, graphs, diagrams, plots) and explain how misleading representations affect interpretations and conclusions about data.</p>
Determine the probability of a simple event	<p><b>MA-6-DAP-S-P4</b> Students will determine simple probabilities based on the results of an experiment and make inferences based on the data.</p>
Exhibit knowledge of simple counting techniques*	<p><b>MA-6-DAP-S-P2</b> Students will investigate solutions to probability problems using counting techniques, tree diagrams, charts and tables.</p> <p><b>MA-7-DAP-S-P7</b> Students will apply counting techniques to determine the size of a sample space.</p> <p><b>MA-8-DAP-S-P4</b> Students will compute and interpret the expected value of random variables in simple cases.</p>

\* PLAN and ACT only

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Score Range 24-27	
Calculate the average, given the frequency counts of all the data values	<b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.
Manipulate data from tables and graphs	<b>MA-6-DAP-S-DR2</b> Students will collect, organize, construct, analyze and interpret data in a variety of graphical methods, including line plots, line graphs, circle graphs, bar graphs and stem-and-leaf plots.  <b>MA-7-DAP-S-DR1</b> Students will collect, organize, construct, analyze and interpret data and data displays in a variety of graphical methods, including circle graphs, multiple line graphs, double bar graphs and double stem-and-leaf plots.  <b>MA-8-DAP-S-DR1</b> Students will collect, organize, construct, analyze and make inferences from data in a variety of graphical methods (e.g., drawings, tables/charts, pictographs, bar graphs, circle graphs, line plots, Venn diagrams, line graphs, stem-and-leaf plots, scatter plots, histograms, box-and-whiskers plots).
Compute straightforward probabilities for common situations	<b>MA-6-DAP-S-P4</b> Students will determine simple probabilities based on the results of an experiment and make inferences based on the data.
Use Venn diagrams in counting*	<b>MA-8-DAP-S-DR1</b> Students will collect, organize, construct, analyze and make inferences from data in a variety of graphical methods (e.g., drawings, tables/charts, pictographs, bar graphs, circle graphs, line plots, Venn diagrams, line graphs, stem-and-leaf plots, scatter plots, histograms, box-and-whiskers plots).
Score Range 28-32*	
Calculate or use a weighted average	<b>MA-8-DAP-S-CD3</b> Students will determine and interpret the mean, median, mode and range of a set of data.
Interpret and use information from figures, tables and graphs	<b>MA-8-DAP-S-DR1</b> Students will collect, organize, construct, analyze and make inferences from data in a variety of graphical methods (e.g., drawings, tables/charts, pictographs, bar graphs, circle graphs, line plots, Venn diagrams, line graphs, stem-and-leaf plots, scatter plots, histograms, box-and-whiskers plots).
Apply counting techniques	<b>MA-8-DAP-S-P4</b> Students will investigate counting techniques (e.g., networks).
Compute a probability when the event and/or sample space are not given or obvious	<b>MA-HS-DAP-S-P2</b> Students will apply the concepts of sample space and probability distribution to construct sample spaces and distributions in simple cases.

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Score Range 33-36†	
Distinguish between mean, median, and mode for a list of numbers	<b>MA-7-DAP-S-CD2</b> Students will determine, apply and compare measures of mean, median, mode and/or range, as appropriate to the problem situation.
Analyze and draw conclusions based on information from figures, tables, and graphs	<b>MA-8-DAP-S-DR1</b> Students will collect, organize, construct, analyze and make inferences from data in a variety of graphical methods (e.g., drawings, tables/charts, pictographs, bar graphs, circle graphs, line plots, Venn diagrams, line graphs, stem-and-leaf plots, scatter plots, histograms, box-and-whiskers plots).
Exhibit knowledge of conditional and joint probability	<b>MA-HS-DAP-S-P5</b> Students will apply the concepts of conditional probability and independent events and be able to compute those probabilities.  <b>MA-HS-DAP-S-P6</b> Students will compute the probability of a compound event.

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# Mathematics

## POS/CRS Alignment

### Strand 3 – Number: Concepts & Properties (NCP)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Recognize equivalent fractions and fractions in lowest terms	<b>MA-7-NPO-S-NS5</b> Students will compare, order and determine equivalent relationships among fractions, decimals and percents.
Score Range 16-19	
Recognize one-digit factors of a number	<b>MA-4- NPO-S-PNO1</b> Students will determine factors/multiples of a whole number.
Identify a digit's place value	<b>MA-6-NPO-S-NS3</b> Students will develop place value of large and small numbers, including decimals.

\* PLAN and ACT only

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Score Range 20-23	
Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor	<p><b>MA-6-NPO-S-NS5</b> Students will compare, order and convert between whole numbers, fractions, decimals and percents using concrete materials, drawings or pictures and mathematical symbols.</p> <p><b>MA-6-NPO-S-E1</b> Students will estimate and mentally compute to solve real-world and/or mathematical problems with whole numbers, fractions, decimals and percents, checking for reasonable and appropriate computational results.</p> <p><b>MA-6-NPO-S-PNO1</b> Students will determine prime numbers, composite numbers, prime factorization, factors, multiples, greatest common factor and least common multiple.</p> <p><b>MA-6-NPO-S-PRF1</b> Students will recognize, create and extend patterns (give an informal description of the continuation of a pattern and/or generalize a pattern through a verbal rule).</p> <p><b>MA-8-NPO-S-NS2</b> Students will provide examples of, describe and compare irrational and rational numbers (e.g., magnitude, order on a number line, scientific notation, very large and very small integers, numbers close to zero).</p>
Score Range 24-27	
Find and use the least common multiple	<b>MA-6-NPO-S-PNO1</b> Students will determine prime numbers, composite numbers, prime factorization, factors, multiples, greatest common factor and least common multiple.
Order fractions	<b>MA-6-NPO-S-NS5</b> Students will explore, investigate, compare, relate and apply relationships among whole numbers, fractions, decimals and percents.
Work with numerical factors	<b>MA-6-NPO-S-PNO3</b> Students will use prime numbers, composite numbers, factors, multiples and divisibility to solve problems.
Work with scientific notation	<b>MA-8-NPO-S-NS2</b> Students will provide examples of, describe and compare irrational and rational numbers (e.g., magnitude, order on a number line, scientific notation, very large and very small integers, numbers close to zero).
Work with squares and square roots of numbers	<b>MA-8-NPO-S-NS1</b> Students will continue to develop number sense to include irrational numbers (e.g., square roots, cube roots, $\pi$ ).

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Work problems involving positive integer exponents*	<b>MA-8-NPO-S-NO1</b> Students will add, subtract, multiply, divide and apply order of operations (including positive whole number exponents) using rational numbers to solve real-world problems.
Work with cubes and cube roots of numbers*	<b>MA-8-NPO-S-NS3</b> Students will describe and provide multiple representations of numbers (rational, square roots, cube roots and $\pi$ ) in a variety of equivalent forms using models, diagrams and symbols based on real-world and/or mathematical situations.
Determine when an expression is undefined*.	<b>MA-HS-AT-S-VEO10</b> Students will determine when an expression is undefined.
Exhibit some knowledge of the complex numbers†	<b>MA-HS-NPO-S-NO2</b> Students will add, subtract and multiply complex numbers.
<b>Score Range 28-32*</b>	
Apply number properties involving prime factorization	<b>MA-6-NPO-S-PNO1</b> Students will determine prime numbers, composite numbers, prime factorization, factors, multiples, greatest common factor and least common multiple.
Apply number properties involving even/odd numbers and factors/multiples	<b>MA-6-NPO-S-PNO1</b> Students will determine prime numbers, composite numbers, prime factorization, factors, multiples, greatest common factor and least common multiple.
Apply number properties involving positive/negative numbers	<b>MA-7-NPO-S-PNO1</b> Students will identify, explain and apply properties (e.g., commutative, associative, inverse and identity for addition and multiplication; distributive).
Apply rules of exponents	<b>MA-HS-AT-S-VEO5</b> Students will understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.
Multiply two complex numbers†	<b>MA-HS-NPO-S-NO2</b> Students will add, subtract and multiply complex numbers.
<b>Score Range 33-36†</b>	
Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers	<b>MA-HS-AT-S-VEO3</b> Students will use symbolic expressions, including iterative and recursive forms, to represent relationships among various contexts.
Exhibit knowledge of logarithms and geometric sequences	<b>MA-HS-AT-S-PRF19</b> Students will relate the patterns in geometric sequences to exponential functions.

\* PLAN and ACT only

† ACT only

Apply properties of complex numbers	<b>MA-HS-NPO-S-NO2</b> Students will add, subtract and multiply complex numbers.
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# Mathematics

## POS/CRS Alignment

### Strand 4 – Expressions, Equations, & Inequalities (XEI)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$ )	<b>MA-6-AT-S-VEO1</b> Students will explore the use of variables in expressions and equations.
Solve equations in the form $x + a = b$ , where $a$ and $b$ are whole numbers or decimals	<b>MA-6-AT-S-EI3</b> Students will model and solve real-world problems with one variable equations and inequalities (e.g., $8x=4$ , $x+2>5$ ).
Score Range 16-19	
Substitute whole numbers for unknown quantities to evaluate expressions	<b>MA-6-AT-S-VEO2</b> Students will substitute numerical values for variables and evaluate algebraic expressions.
Solve one-step equations having integer or decimal answers	<b>MA-7-AT-S-EI3</b> Students will model and solve real-world problems with one- or two-step equations or inequalities (e.g., $2x+1=9$ , $3x+3<9$ ).
Combine like terms (e.g., $2x + 5x$ )	<b>MA-7-AT-S-VEO1</b> Students will simplify numeric and algebraic expressions.
Score Range 20-23	
Evaluate algebraic expressions by substituting integers for unknown quantities	<b>MA-6-AT-S-VEO2</b> Students will substitute numerical values for variables and evaluate algebraic expressions.
Add and subtract simple algebraic expressions	<b>MA-7-AT-S-VEO1</b> Students will simplify numeric and algebraic expressions.
Solve routine first-degree equations	<b>MA-6-AT-S-EI3</b> Students will model and solve real-world problems with one variable equations and inequalities (e.g., $8x=4$ , $x+2>5$ ).
Perform straightforward word-to-symbol translations	<b>MA-8-AT-S-VEO3</b> Students will describe, define and provide examples of variables and expressions with a missing value based on real-world and/or mathematical situations.

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Multiply two binomials*	<b>MA-HS-AT-S-VEO6</b> Students will add, subtract and multiply polynomials.
Score Range 24-27	
Solve real-world problems using first-degree equations	<b>MA-6-AT-S-EI3</b> Students will model and solve real-world problems with one variable equations and inequalities (e.g., $8x=4$ , $x+2>5$ ).
Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)	<b>MA-8-AT-S-VEO3</b> Students will describe, define and provide examples of variables and expressions with a missing value based on real-world and/or mathematical situations.  <b>MA-8-AT-S-EI4</b> Students will model and solve real-world problems with one- or two-step equations or inequalities (e.g., $4x+2=22$ , $x-4<-60$ ).
Identify solutions to simple quadratic equations	<b>MA-8-AT-S-PRF2</b> Students will represent, interpret and describe linear and simple quadratic functional relationships (input/output) through tables, graphs and symbolic rules.
Add, subtract, and multiply polynomials*	<b>MA-HS-AT-S-VEO6</b> Students will add, subtract and multiply polynomials.
Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)*	<b>MA-HS-AT-S-VEO9</b> Students will factor quadratic polynomials.
Solve first-degree inequalities that do not require reversing the inequality sign*	<b>MA-8-AT-S-EI4</b> Students will model and solve real-world problems with one- or two-step equations or inequalities (e.g., $4x+2=22$ , $x-4<-60$ ).
Score Range 28-32*	
Manipulate expressions and equations	<b>MA-HS-AT-S-VEO 4</b> Students will judge the meaning, utility and reasonableness of the results of symbol manipulations, including those carried out using technology.
Write expressions, equations, and inequalities for common algebra settings	<b>MA-HS-AT-S-VEO2</b> Students will use symbolic algebra to represent and explain mathematical relationships.
Solve linear inequalities that require reversing the inequality sign	<b>MA-HS-AT-S-EI4</b> Students will solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

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Solve absolute value equations	<b>MA-HS-AT-S-EI19</b> Students will use the skills learned to solve linear equations and inequalities to solve numerically, graphically or symbolically non-linear equations (e.g., absolute value, quadratic, exponential equations).
Solve quadratic equations	<b>MA-HS-AT-S-EI19</b> Students will use the skills learned to solve linear equations and inequalities to solve numerically, graphically or symbolically non-linear equations (e.g., absolute value, quadratic, exponential equations).
Find solutions to systems of linear equations	<b>MA-HS-AT-S-EI16</b> Students will solve systems of two linear equations in two variables.
Score Range 33-36†	
Write expressions that require planning and/or manipulating to accurately model a situation	<b>MA-HS-AT-S-VE04</b> Students will judge the meaning, utility and reasonableness of the results of symbol manipulations, including those carried out using technology.
Write equations and inequalities that require planning, manipulating, and/or solving	<b>MA-HS-AT-S-VE04</b> Students will judge the meaning, utility and reasonableness of the results of symbol manipulations, including those carried out using technology.
Solve simple absolute value inequalities	<b>MA-HS-AT-S-EI4</b> Students will solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

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# Mathematics

## POS/CRS Alignment

### Strand 5 – Graphical Representation (GRE)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Identify the location of a point with a positive coordinate on the number line	<b>MA-P-NPO-S-NS2</b> Students will apply multiple representations (e.g., drawings, manipulatives, base-10 blocks, number lines, expanded form, symbols) to describe and compare whole numbers and fractions (e.g., halves, thirds, fourths) in mathematical and real-world problems.
Score Range 16-19	
Locate points on the number line and in the first quadrant	<b>MA-6-G-S-CG1</b> Students will identify and graph ordered pairs on a positive coordinate system, identifying the origin, axes and ordered pairs.
Score Range 20-23	
Locate points in the coordinate plane	<b>MA-7-G-S-GC1</b> Students will identify and graph ordered pairs on a coordinate system, identifying the origin, axes and ordered pairs.
Comprehend the concept of length on the number line*	<b>MA-HS-NPO-S-NS2</b> Students will locate the position of a real number on the number line, find its distance from the origin (absolute value/magnitude) and find the distance between two numbers on the number line (the absolute value of their difference).
Exhibit knowledge of slope*	<b>MA-8-G-S-CG2</b> Students will analyze the graph of a line to determine the slope, y-intercept and equation of the line.
Score Range 24-27	
Identify the graph of a linear inequality on the number line*	<b>MA-HS-AT-S-EI3</b> Students will solve one-variable equations and inequalities using manipulatives, symbols, procedures and graphing, including graphing the solution set on a number line.
Determine the slope of a line from points or equations*	<b>MA-8-G-S-CG2</b> Students will analyze the graph of a line to determine the slope, y-intercept and equation of the line.  <b>MA-HS-G-S-CG1</b> Students will express the intuitive concept of the “slant” of a line as slope, use the coordinates of two points on a line to determine its slope and use slope to express the parallelism and perpendicularity of lines.

\* PLAN and ACT only

† ACT only

Match linear graphs with their equations*	<b>MA-HS-G-S-CG2</b> Students will describe a line by a linear equation.
Find the midpoint of a line segment*	<b>MA-HS-G-S-CG5</b> Students will find the midpoint of a segment when the coordinates of the endpoints are identified.
Score Range 28-32*	
Interpret and use information from graphs in the coordinate plane	<b>MA-8-G-S-CG1</b> Students will identify and graph ordered pairs on a coordinate system, identifying the origin, axes and ordered pairs; apply graphing in the coordinate system to solve real-world problems.
Match number line graphs with solution sets of linear inequalities	<b>MA-HS-AT-S-EI3</b> Students will solve one-variable equations and inequalities using manipulatives, symbols, procedures and graphing, including graphing the solution set on a number line.
Use the distance formula	<b>MA-HS-G-S-CG3</b> Students will find the distance between two points using their coordinates and the Pythagorean theorem or the distance formula.
Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point	<b>MA-HS-G-S-CG1</b> Students will express the intuitive concept of the “slant” of a line as slope, use the coordinates of two points on a line to determine its slope and use slope to express the parallelism and perpendicularity of lines.
Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)†	<b>MA-HS-G-S-CG4</b> Students will find the equation of a circle given its center and radius; given the equation of a circle, find its center and radius.  <b>MA-HS-AT-S-EI16</b> Students will graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of the graph.
Score Range 33-36†	
Match number line graphs with solution sets of simple quadratic inequalities	<b>MA-HS-AT-S-EI19</b> Students will use the skills learned to solve linear equations and inequalities to solve numerically, graphically or symbolically non-linear equations (e.g., absolute value, quadratic, exponential equations).
Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$	<b>MA-HS-AT-S-PRF3</b> Students will analyze functions by investigating rates of change, intercepts, zeros, asymptotes and local and global behavior.
Solve problems integrating multiple algebraic and/or geometric concepts	<b>MA-HS-AT-U3 Algebra</b> Students will representation mathematical situations and structures for analysis and problem solving.

\* PLAN and ACT only

† ACT only

Analyze and draw conclusions based on information from graphs in the coordinate plane	<b>MA-HS-AT-PRF13</b> Students will graph linear, absolute value, quadratic and exponential functions and identify their key characteristics.
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# Mathematics

## POS/CRS Alignment

### Strand 6 – Properties of Plane Figures (PPF)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 16-19	
Exhibit some knowledge of the angles associated with parallel lines	<b>MA-7-G-S-SR2</b> Students will identify characteristics of angles (e.g., adjacent, vertical, corresponding, interior, exterior).
Score Range 20-23	
Find the measure of an angle using properties of parallel lines	<b>MA-7-G-S-SR2</b> Students will identify characteristics of angles (e.g., adjacent, vertical, corresponding, interior, exterior).
Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)	<b>MA-7-G-S-SR3</b> Students will identify properties for classifying, describe, provide examples of and identify elements (e.g., sides, vertices, angles, congruent parts) of two-dimensional figures (circles, triangles [acute, right, obtuse, scalene, isosceles, equilateral], quadrilaterals [square, rectangle, rhombus, parallelogram, trapezoid], regular and irregular polygons); apply properties of these figures to solve real-world problems.
Score Range 24-27	
Use several angle properties to find an unknown angle measure	<b>MA-7-M-S-MPA2</b> Students will estimate and find angle measures and segment measures.
Recognize Pythagorean triples*	<b>MA-8-M-S-MPA6</b> Students will develop and apply the Pythagorean theorem.
Use properties of isosceles*	<b>MA-6-G-S-SR4</b> Students will identify, describe and provide examples and properties of two-dimensional figures (circles, triangles [acute, right, obtuse, scalene, isosceles, equilateral], quadrilaterals, regular polygons); apply these properties and figures to solve real-world problems.
Score Range 28-32*	
Apply properties of 30°-60°-90°, 45°-45°-90°, similar and congruent triangles	<b>MA-HS-M-S-MPA7</b> Students will apply special right triangles and the converse of the Pythagorean theorem to solve realistic problems.

\* PLAN and ACT only

† ACT only

Use the Pythagorean theorem	<b>MA-8-M-S-MPA6</b> Students will develop and apply the Pythagorean theorem.
Score Range 33-36†	
Draw conclusions based on a set of conditions	<b>MA-HS-G-S-SR1</b> Students will identify and apply the definitions, properties and theorems about line segments, rays and angles and use them to prove theorems in Euclidean geometry, solve problems and perform basic geometric constructions using a straight edge and a compass.
Solve multistep geometry problems that involve integrating concepts, planning, visualization and/or making connections with other content areas	<b>MA-HS-G-S-SR12</b> Students will use geometric models and ideas to gain insights into and answer questions in other areas of mathematics and into other disciplines and areas of interest, such as art and architecture.
Use relationships among angles, arcs and distances in a circle	<b>MA-HS-G-S-SR5</b> Students will use the definitions and basic properties of a circle (e.g., arcs, chords, central angles, inscribed angles) to prove basic theorems and solve problems.

\* PLAN and ACT only

† ACT only

# Mathematics

## POS/CRS Alignment

### Strand 7—Measurement (MEA)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 13-15	
Estimate or calculate the length of a line segment based on other lengths given on a geometric figure	<b>MA-6-G-S-SR4</b> Students will identify, describe and provide examples and properties of two-dimensional figures (circles, triangles [acute, right, obtuse, scalene, isosceles, equilateral], quadrilaterals, regular polygons); apply these properties and figures to solve real-world problems.
Score Range 16-19	
Compute the perimeter of polygons when all side lengths are given	<b>MA-6-M-S-MPA1</b> Students will find perimeter of regular and irregular polygons in metric and U.S. customary units.
Compute the area of rectangles when whole number dimensions are given	<b>MA-6-M-S-MPA3</b> Students will find area of plane figures composed of triangles, squares and rectangles by subdividing and measuring; use square units appropriately.
Score Range 20-23	
Compute the area and perimeter of triangles and rectangles in simple problems	<b>MA-7-M-S-MPA5</b> Students will determine the length of sides (to the nearest eighth of an inch or nearest centimeter), area and perimeter of triangles, quadrilaterals (rectangles, squares, trapezoids) and other polygons. (Using the Pythagorean theorem will not be required as a strategy).
Use geometric formulas when all necessary information is given	<b>MA-8-AT-S-VEO2</b> Students will given a formula, substitute appropriate elements from a real-world or mathematical situation.
Score Range 24-27	
Compute the area of triangles and rectangles when one or more additional simple steps are required	<b>MA-8-M-S-MPA4</b> Students will determine the area of triangles and quadrilaterals.
Compute the area and circumference of circles after identifying necessary information	<b>MA-7-M-S-MPA3</b> Students will estimate and find circle measurements in standard units (radius, diameter, circumference, area) and relationships among them.

\* PLAN and ACT only

† ACT only

Compute the perimeter of simple composite geometric figures with unknown side lengths*	<b>MA-8-M-S-MPA3</b> Students will determine measures of the lengths of sides and the perimeter both regular and irregular shapes, including lengths to the nearest sixteenth of an inch or the nearest millimeter.
Score Range 28-32*	
Use relationships involving area, perimeter, and volume of geometric figures to compute another measure	<b>MA-7-M-S-MPA6</b> Students will explain how measurements and measurement formulas are related or different (e.g., perimeter and area of rectangles).
Score Range 33-36†	
Use scale factors to determine the magnitude of a size change	<b>MA-8-G-S-SR5</b> Students will apply proportional reasoning to solve problems involving scale models and real objects and scale drawings and similar two-dimensional figures.
Compute the area of composite geometric figures when planning or visualization is required	<b>MA-6-M-S-MPA3</b> Students will find area of plane figures composed of triangles, squares and rectangles by subdividing and measuring; use square units appropriately.

\* PLAN and ACT only

† ACT only

# Mathematics

## POS/CRS Alignment

### Strand 9—Functions (FUN)

College Readiness Benchmarks	Kentucky Program of Studies
Score Range 20-23	
Evaluate quadratic functions, expressed in function notation, at integer values†	<b>MA-HS-AT-S-VEO12</b> Students will evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.
Score Range 24-27	
Evaluate polynomial functions, expressed in function notation, at integer values†	<b>MA-HS-AT-S-VEO12</b> Students will evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.
Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths†	<b>MA-HS-M-S-MPA6</b> Students will apply definitions and properties of right triangle relationships (basic right triangle trigonometry and the Pythagorean theorem) to determine length and angle measures to solve realistic problems.
Score Range 28-32	
Evaluate composite functions at integer values†	<b>MA-HS-AT-S-VEO12</b> Students will evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.
Apply basic trigonometric ratios to solve right-triangle problems†	<b>MA-HS-M-S-MPA7</b> Students will apply special right triangles and the converse of the Pythagorean theorem to solve realistic problems.

\* PLAN and ACT only

† ACT only

Score Range 33-36	
Write an expression for the composite of two simple functions†	<b>MA-HS-AT-S-PRF12</b> Students will combine functions by addition, subtraction, multiplication and compositions.
Use trigonometric concepts and basic identities to solve problems†	<b>MA-HS-M-S-MPA6</b> Students will apply definitions and properties of right triangle relationships (basic right triangle trigonometry and the Pythagorean theorem) to determine length and angle measures to solve realistic problems.
Exhibit knowledge of unit circle trigonometry†	<b>MA-HS-M-S-MPA5</b> Students will explore the relationships between the right triangle trigonometric functions, using technology (e.g., graphing calculator) as appropriate.
Match graphs of basic trigonometric functions with their equations†	<b>MA-HS-M-S-MPA5</b> Students will explore the relationships between the right triangle trigonometric functions, using technology (e.g., graphing calculator) as appropriate.

\* PLAN and ACT only

† ACT only

# **Mathematics Test EPAS Test Breakdown Supplemental Information**

**What does the Mathematics Test Measure?** The mathematics test “requires students to analyze problems in real-world and purely mathematical settings, plan and carry out solutions strategies, and verify the appropriateness of solutions.” Students must demonstrate understanding of mathematical terminology. Students will be required to apply definitions, algorithms, theorems and properties to solve problems. Students will also be expected to analyze and interpret data.

Mathematics Test		
EXPLORE	<b>EXPLORE Mathematics Test Design</b> — 30 minutes to answer 30 multiple choice questions	
	<b>Content Area (Strands)</b>	<b>Percent of Questions</b>
	<b>Probability, Statistics, &amp; Data Analysis</b> includes Probability, Statistics and Data Analysis	13%
	<b>Pre-Algebra</b> includes Basic Operations and Applications; Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations, and Inequalities	33%
	<b>Elementary Algebra</b> includes Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations and Inequalities	30%
	<b>Pre-Geometry</b> includes Graphical Representations, Properties of Plane Figures and Measurement	23%
PLAN	<b>PLAN Mathematics Test Design</b> — 40 minutes to answer 40 multiple choice questions	
	<b>Content Area (Strands)</b>	<b>Percent of Questions</b>
	<b>Pre-Algebra</b> includes Basic Operations and Applications; Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations and Inequalities	35%
	<b>Elementary Algebra</b> includes Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations and Inequalities	20%
	<b>Coordinate Geometry</b> includes Graphical Representations, Measurement and Functions	18%
	<b>Plane Geometry</b> includes Properties of Plane Figures and Measurement	27%

ACT	<b>ACT Mathematics Test Design</b> — 60 minutes to answer 60 multiple choice questions	
	<b>Content Area (Strands)</b>	<b>Percent of Questions</b>
	<b>Pre-Algebra</b> includes Basic Operations and Applications; Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations and Inequalities	23%
	<b>Elementary Algebra</b> includes Probability, Statistics and Data Analysis; Number Concepts and Properties; and Expressions, Equations and Inequalities	17%
	<b>Intermediate Algebra</b> includes Number Concepts and Properties, Functions	15%
	<b>Coordinate Geometry</b> includes Graphical Representations, Measurement and Functions	15%
	<b>Plane Geometry</b> Includes Properties of Plane Figures and Measurement	23%
	<b>Trigonometry</b> includes Functions	7%

### Mathematics Strands

Basic Operations and Applications (BOA)

Probability, Statistics and Data Analysis (PSD)

Numbers: Concepts and Properties (NCP)

Expressions, Equations and Inequalities (XEI)

Graphical Representations (GRE)

Properties of Plane Figures (PPF)

Measurement (MEA)

Functions (FUN)—This strand is tested ONLY on the ACT exam.

The Mathematics Test contains items that fall under four cognitive levels:

- Knowledge and Skills—these questions require the use of mathematical facts, definitions, formulas or procedures to solve problems that are strictly mathematical.
- Direct Application—these questions involve applying mathematical facts, definitions, formulas or procedures to solve problems with real-world context.
- Understanding Concepts—these questions assess students' understanding of concepts required to make an inference or draw a conclusion.
- Integrating Conceptual Knowledge—these questions appraise students' ability to integrate understanding of major concepts to solve non-routine problems.

### References

*The ACT: Connecting College Readiness Standards to the Classroom for Mathematics Teachers.* ACT, Inc., Iowa City, IA. 2005: 17-18.

Your Guide to ACT. ACT. 27 May 2008.

<http://www.act.org/aap/pdf/YourGuidetoACT.pdf>